UtahStateUniversity
COOPERATIVE EXTENSION

ENERGY SMARTS: INSULATING CONCRETE FORMS (ICFS)

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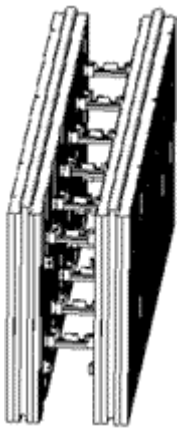
Insulating Concrete Forms (ICFs) are hollow molds with a center cavity that is filled with reinforced concrete. The forms are usually made of rigid polystyrene or polyurethane insulation, and are produced as either pre-formed interlocking blocks, or as separate panels connected with plastic or steel rods and ties (see Figure 1).

Figure 1. Insulated Concrete Form



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ICF structures are built by fitting together the insulating forms, adding steel reinforcing bars (rebar) for strength, and then filling the central cavity with concrete. The insulating forms, rebar, and concrete walls stay in place as a permanent part of the wall. The outer surface of the walls creates a supportive backing for most conventional finishing materials such as stucco. Some brands of ICF's come with nailing strips so that gypsum can be used on the interior walls.

BENEFITS OF ICFS

Insulation

ICFs provide very good insulation. The R-value (a measure of effectiveness as an insulator) of ICFs is typically rated R-18 to R-35, depending on the thickness of the wall. In comparison, 2x4 wood framed walls are usually rated R-10 to R-12; 2 x 6 wood framed walls are rated around R-19. For the same wall thickness of a 2 x 6 wood framed wall, ICFs provide an R-value of about 20.

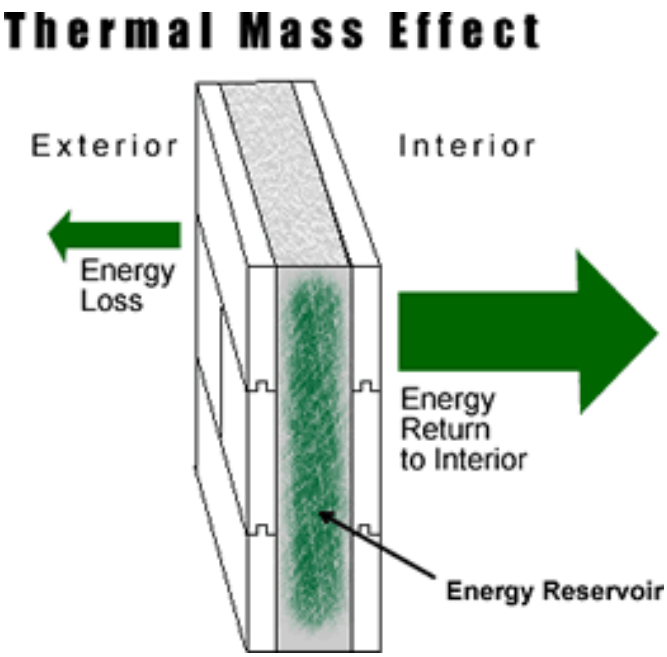
Thermal Mass Effect

The mass of the concrete core of ICFs adds significantly to the thermal efficiency of the structure (see Figure 2). The concrete acts as an energy reservoir, reducing temperature changes from day to night (ECO-Block, 2005).

Energy Efficiency

Homes built with ICFs typically require less energy to heat and cool than typical wood framed homes. This is due to higher R-values and reduced air leaks. Air leaks are associated with air infiltration, which impacts energy gain or loss in the structure.

Figure 2. Thermal Mass



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Sound Proofing
ICF walls can help buffer the interior of a home from outdoor noise. Concrete is a material that tends to reflect noise, while foam insulation absorbs sound. The combination of foam and concrete creates a thick wall that serves as an excellent sound barrier.

Wind Resistance
ICF walls provide good resistance to storms and strong winds. According to tests performed at Texas Tech University, ICF walls were less likely to suffer damage in high winds than conventional wood framed houses. Additionally, the uniform thickness of ICF walls can help reduce drafts and cold spots associated with gaps in insulating material.

Fire Resistance
ICF walls provide good fire resistance. ICFs can prevent the spread of fire from one side of a wall to the other, and they are capable of withstanding exposure to intense flame longer than common wood frame walls. And unlike wood and steel, concrete will not burn or bend during a fire. In addition, the foam insulation will not fuel a fire because it is made with flame retardant additives that cause it to melt when exposed to flames. However, depending on the type of foam used, melting may emit toxic fumes. According to tests done by the Southwest Research Institute, the emissions released by burning polystyrene foams are no more toxic than those of burning wood (McMichael, 1999).

Less Maintenance
ICFs with foam insulation are resistant to rot and termite infestation, problems that are common in wood homes and costly to repair. Foam generally does not support mold growth which prefers wood over foam.

Simplicity
ICF structures are easy to build. ICF homes combine framing, installation of insulation, and sheathing into one step. An experienced contractor can construct an ICF home in less time than it would take to construct a wood framed house, thus creating labor cost savings.

Flexibility
ICFs can be used with most conventional finishes or designs. Moreover, ICFs can easily be cut with a saw, so curves and odd angles are usually not a problem.

CONCERNS ABOUT BUILDING WITH ICFS

Availability
Builders and architects may be uncomfortable working with ICFs unless they have had experience or training. Even though ICF construction is becoming more common, it may be difficult to find experienced ICF builders in some areas.

Use of Non-renewable Resources
Although the ICFs are often made with recycled content, polystyrene and polyethylene, they are made of plastic. Plastics originate from fossil fuels. Still, by using ICFs, demand for lumber materials are decreased, reducing the strain on forests.

COMMON SYSTEMS

ICFs come in block and panel systems. The block systems are factory-molded, hollow core polystyrene blocks that interlock to create a cavity that is filled with concrete. Rebar is used inside the form to add strength. Block systems have the smallest individual units; typical blocks are 10″wide overall with a 6″center cavity for concrete. The panel systems are flat panels that are attached

together with plastic or steel rods and ties. The panels are assembled into units before they are put in place. Panel systems have the largest individual units from about 1′x8′ to 4′x12′.

ICF cavities fall into three categories: the flat wall, post and beam, and grid wall cavities. The flat wall cavities produce a uniform thickness of concrete throughout the wall. The post and beam cavities produce long horizontal and vertical columns of concrete. The grid wall cavities produce a crisscross pattern of concrete throughout the wall.

Insulation forms come in several different materials such as expanded polystyrene, extruded polystyrene, polyurethane, or cement bonded wood fibers. Expanded polystyrene is similar to the white foam commonly used in coffee cups; it can have recycled content and is usually the least expensive material. Extruded polystyrene is similar to the foam trays used for supermarket meats, it is slightly more expensive than expanded polystyrene, but has a higher insulating value. Extruded polystyrene forms usually include some recycled content. Polyurethane provides a high insulating value, is typically the most expensive material, and usually includes some recycled content. Cement bonded wood fiber forms are composed of recycled waste wood that is bonded together with cement. This is the only non-petroleum based ICF material.

WHAT IS THE COST OF BUILDING WITH ICFS?

According to the U.S. Department of Energy (2003), ICFs can initially cost up to 4 percent more than standard wood framing wall. However, the rising lumber prices have made the cost of building with ICFs more comparable to the cost of building with wood framing and generally labor costs are less with ICFs.

It is important to consider that homes built with ICF walls are very well insulated, have higher R-values, and fewer air leaks, which can translate into savings on monthly utility bills. In addition, the reduced heating and cooling needs may allow homeowners to purchase smaller heating and cooling devices, resulting in savings in initial equipment cost. Furthermore, ICF built homes can usually be constructed faster than traditional wood framed homes, reducing the cost of construction labor. It is important to note that savings may vary depending on climate and regional energy costs.

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